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(54) IMPROVEMENTS IN OR RELATING TO TENSION CONTROL APPARATUS FOR TEXTILE WEBS

(71) We, JOHN GLADSTONE & CO. (ENGINEERING) LIMITED, a British Company, of Beechbank Works, Galashiels, Scotland, do hereby declare the invention, for which we pray that patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to tension control apparatus for textile webs.

During the preparation of textile webs for treatment in the autoclave or for decatising or blowing, or any similar process in which the rolled web is subjected to chemical or thermal treatment, it is highly advantageous for the web tension to be accurately controlled during rolling. The present invention provides an improved means for controlling web tension during rolling.

According to the present invention there is provided tension control apparatus for textile webs comprising means for continuously measuring and comparing the number of weft threads per unit length of web with a reference and means for automatically varying the web tension in dependence on the comparison in such a manner as to reduce any variation of said number from the reference value.

Preferred features and advantages of the invention will become apparent from the following description of an embodiment of apparatus according to the invention, taken in conjunction with the accompanying schematic diagram illustrating the embodiment.

In the drawing a knitted or woven web 1 moves in the direction of arrow 2 towards a batching apparatus (not shown) in which it is rolled upon a core for treatment. The web passes over a guide roller 3 and around a control drum 4 and thence by way of a tension-measuring device 5 to be rolled. In order to ensure that the web is rolled under an appropriate tension the number of threads, i.e. picks per unit length of web is compared with a reference and any departure from the reference and therefore from the desired condition of the web is arranged appropriately to vary the web tension. For this purpose there is developed a first signal representative of the number of threads in the web passing a given point in unit time. Conveniently a part 1*a* of the web is illuminated by a light source, conveniently comprising an electric lamp 6 and a concentrating lens 7, and light passing through the web is arranged to fall upon an electrically light-sensitive device 8, for example, a photocell or phototransistor. The signal produced by device 8 as the light falls upon it fluctuates with the passage of the individual threads of the weft between the device and the lights source; the rate of fluctuation or modulation frequency being representative of the number of threads passing the device in unit time. This signal is advantageously used to trigger multivibrator circuits, the output of which is a measure of the number of weft threads or wales passing in unit time. By relating this signal to a second signal representing the rate of advance of the web a measure of the number of threads per unit length may be obtained. To this end in the present embodiment the signal from device 8 is amplified in an amplifier 9 and applied to a control unit 11. To this control unit is fed, by way of a signal channel 12, a further signal obtained from a tachometer generator 13 driven from the shaft of drum 4 and thus yielding a signal representative of the speed of travel of web 1. Appropriate circuits contained within control unit 11 relate these two signals to obtain a count signal representing the number of threads per unit length of the web. Such circuits may for example comprise an oscillator of which the frequency is varied from a preset value in accordance with changes in the web speed. This oscillator signal may be mixed with a shaped signal derived from the output signal from amplifier 9 to yield a difference signal of which the frequency is thus directly related to threads per unit length of the web.

[*Price 25p*]

The difference signal may be filtered to remove unwanted components, and amplified to yield the required count signal.

In a known comparator circuit also contained within control unit 11 the count signal thus obtained is compared with a reference signal obtained from a preset control device 14 and an error signal corresponding to any departure of the thread count from the value represented by the reference signal is derived. This error signal is applied to develop either a first or a second control signal, according as the thread count is too low or too high. These signals are applied to control the tension in the web so as to produce the required result. To this end the first control signal is applied to control the actuation of a first clutch means, 23, conveniently a magnetic clutch, through which control drum 4 is coupled to be driven by a continuously rotating electric motor 24 in the direction to assist the advance of the web. The second control signal is applied to control the actuation of a second clutch means 25, again conveniently a magnetic clutch, through which control drum 4 is braked, the second member of the clutch being fixed. Thus control drum 4 is operated to urge the web onwards or to retard it, by an amount proportional to the error, so as to minimise variations in web tension during the rolling or batching process.

It may also be advantageous to measure the actual web tension and to employ the result of this measurement to control the tension in addition to the thread count. The measurement is made as follows:

On leaving control drum 4 the web 1 passes over the tension measuring device indicated generally by reference 5. This device includes spaced rollers 16, 17 mounted for rotation about their respective axes at the ends of equal-armed and centrally pivoted levers, of which one only is seen at 18. It will be seen that the manner in which the web is led around rollers 16, 17 produces a clockwise torque about the pivot of lever 18. This torque is resisted by a lever arm 19, integral with or secured to lever 18, which applies a force to a force-sensing device 20 yielding a signal representative of the applied force.

The signal derived from device 20 thus represents the torque on lever 18 and thus the tension in the web 1. This signal is applied to control unit 11 in which it is compared with a preferably adjustable tension reference signal received from a preset device 21 to yield error signals representing the magnitude of the discrepancy between the actual and reference values of web tension. A first control signal is produced when the web tension exceeds the reference value, and a second control signal is produced when the measured web tension is less than the reference value.

These control signals may be applied to respective threshold circuits which respond when the web tension exceeds an upper and a lower limit respectively to over-ride the pick-count control and thus to maintain the web tension within a specified range. Specifically, the first error signal is applied to a first threshold circuit which, when the first control signal exceeds a first predetermined threshold level, produces an over-riding signal producing actuation of clutch 23 and release of clutch 25, thus reducing the web tension, while the second control signal is applied to a second threshold circuit which, when the second error signal exceeds a second predetermined threshold level, produces another over-riding signal producing actuation of clutch 25 and release of clutch 23, thus increasing the web tension regardless of the thread count. Alternatively a selector means may be provided on control unit 11 whereby the tension error signal derived from the web tension sensor may be used instead of the count error signal from the thread count sensor to control the web tension to a reference value.

In modified arrangements the web tension may also be automaticaly controlled to take into account the web thickness, the diameter of the batch roll, or any combination of these factors. Suitably, the web tension is raised with increasing web speed, with increasing web thickness and with increasing roll diameter, the control factors varying empirically with the nature of the web. A sensing roller or wheel 28, resiliently biased against guide roller 3, may actuate a transducer 29 yielding a signal representing the web thickness, which signal is applied to control unit 11 over a signal channel 30. In control unit 11 the signal from transducer 29 may be used to vary the web tension in a desired manner. For example, the signal from transducer 29, or a further signal proportional thereto, may be added to the web tension reference signal so as to produce an increase in web tension as the web thickness increases.

In addition, a signal representing the diameter of the batch roll may be obtained by an appropriate sensor actuated by the increasing roll size on the batching roller and may be fed to control unit 11 over a signal channel 22. In control unit 11 the signal from the roll size sensor, or a signal related thereto, may also be added to the web tension reference signal so as to produce an increase in web tension as the roll diameter increases.

The signal from tachometer generator 13, representing the speed of advance of the web, may be treated in known manner to obtain a voltage related to web speed, which voltage is again combined with the web tension reference signal so as to obtain an increase in web tension with web speed.

WHAT WE CLAIM IS:—

1. Tension control apparatus for textile webs comprising means for continuously measuring and comparing the number of weft threads

per unit length of web with a reference and means for automatcially varying the web tension in dependence on the comparison in such a manner as to reduce any variation of said number from the reference value.

2. Apparatus in accordance with claim 1 including means for developing a first signal representative of the number of threads in said web passing a given point in unit time, means for developing a second signal representative of the rate of advance of the web, means relating said first and second signals to obtain a count signal representing the actual number of threads per unit length of web, means for comparing said count signal with a predetermined reference signal representing a desired number of threads per unit length to develop an error signal representative of any departure of said actual number from said desired number and means responsive to said error signal for varying said web tension in such a manner as to reduce said discrepancy.

3. Apparatus in accordance with claim 2 wherein said means for developing said first signal includes a photoelectric device responsive to the passage of said web between said device and a light source to develop a fluctuating electric signal of which the modulation frequency is representative of the number of threads passing a given point in unit time.

4. Apparatus in accordance with claim 2 or claim 3 wherein said means for developing said second signal includes a tachometer generator driven by a drum rotated by the passage thereover of said web.

5. Apparatus in accordance with claim 2, 3 or 4 wherein said means relating said first and second signals comprises an oscillator yielding an output signal of which the frequency varies from a pre-set value in accordance with changes in the web speed represented by said second signal, a mixer fed with said oscillator output signal and with said first signal and yielding a difference signal, and a discriminator yielding an error signal related to the departure of the difference signal from a predetermined value.

6. Apparatus in accordance with any one of claims 2—5 wherein said error signal is used to develop a first or a second control signal according as the actual thread count is too low or too high, said first control signal being applied to control the actuation of first clutch means through which a drum over which the web passes is driven in a direction to assist the advance of the web, and said second control signal being applied to control the actuation of second clutch means through which said drum is braked.

7. Apparatus in accordance with any one of claims 1—6 wherein means are provided for continuously measuring the actual web tension and for additionally employing the result of this measurement to control the web tension.

8. Apparatus in accordance with claim 7 including means for developing a tension signal representative of the web tension and means for comparing said tension signal with a predetermined tension reference signal to yield a first control signal when the actual web tension exceeds the reference value and a second control signal when the actual web tension is less than the reference value, a first threshold circuit responsive to said first error signal exceeding a first threshold level to reduce the web tension and a second threshold circuit responsive to said second error signal exceeding a second threshold level to increase the web tension.

9. Apparatus in accordance with claim 7 as dependant upon any one of claims 2—6 including means for developing a tension signal representative of the web tension, means for comparing said tension signal with a predetermined tension reference signal to yield a tension error signal representative of any discrepancy between said compared signals and selector means operable to apply either said count error signal or said tension error signal to control said web tension varying means.

10. Apparatus in accordance with any one of the preceding claims and including means for developing a signal representative of the web thickness and for applying said signal to increase the web tension as the web thickness increases.

11. Apparatus in accordance with any one of the preceding claims and including means for developing a signal representative of the web speed and for applying said signal to vary the web tension as the web speed increases.

12. Apparatus in accordance with any one of the preceding claims wherein said web is wound into a roll and including means for developing a signal representative of the roll diameter and for applying said signal to vary the web tension as the roll diameter increases.

13. Tension control apparatus for textile webs substantially as described with reference to the accompanying drawing.

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1277087 COMPLETE SPECIFICATION

1 SHEET *This drawing is a reproduction of the Original on a reduced scale*